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(54) **DOOR TRIM PANEL ASSEMBLY AND METHOD OF MAKING**

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(52) **U.S. Cl.** ..... **296/146.7; 296/39.1; 49/502**

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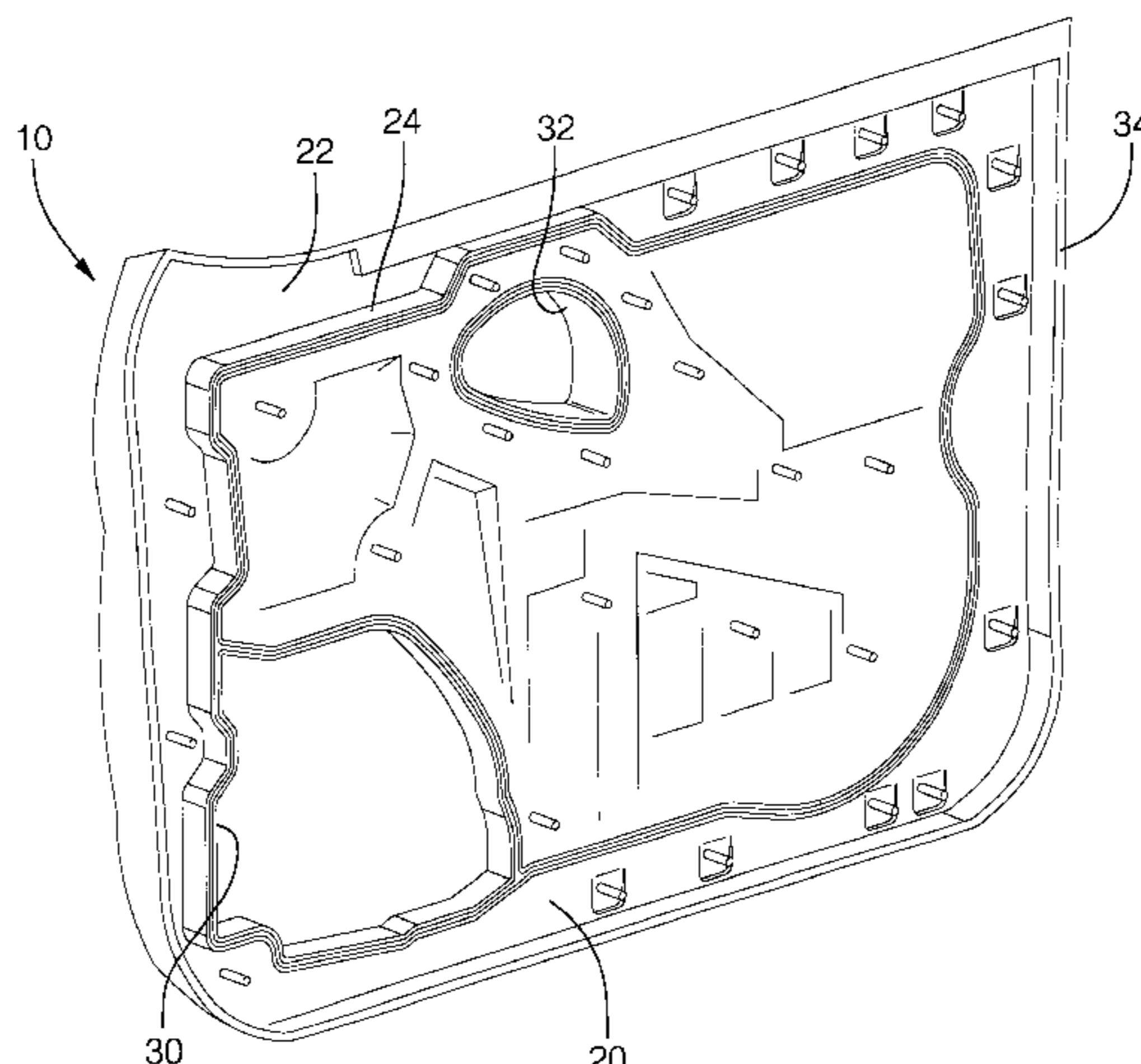
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(57) **ABSTRACT**

A door trim panel assembly and method of making same for attachment to structure of a vehicle includes a door trim panel and a carrier formed from a plastic material attached to the door trim panel and for attachment to the structure of the vehicle. The door trim panel assembly also includes a seal integral with the carrier for contacting the structure to seal the carrier to the structure.

**10 Claims, 3 Drawing Sheets**



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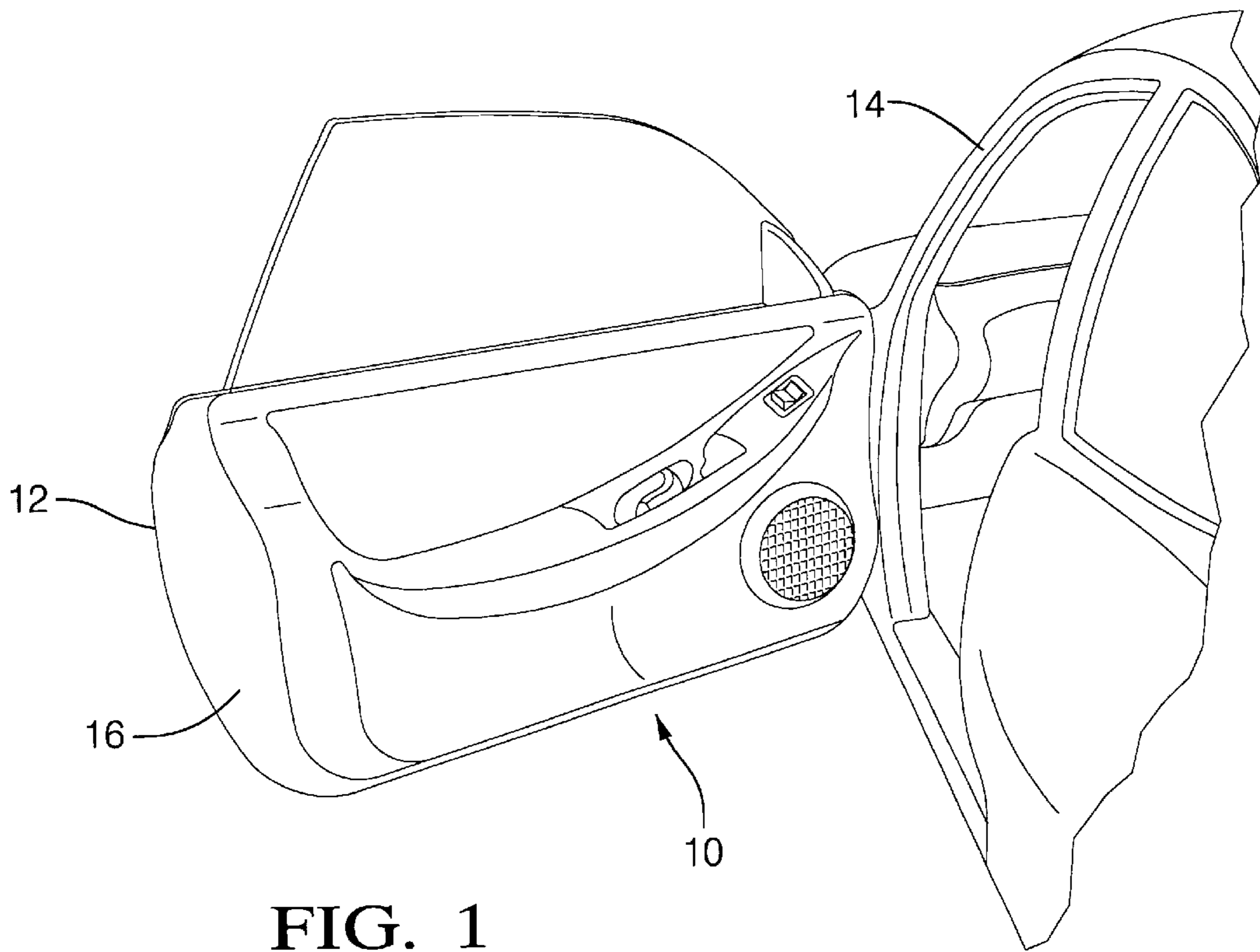


FIG. 1

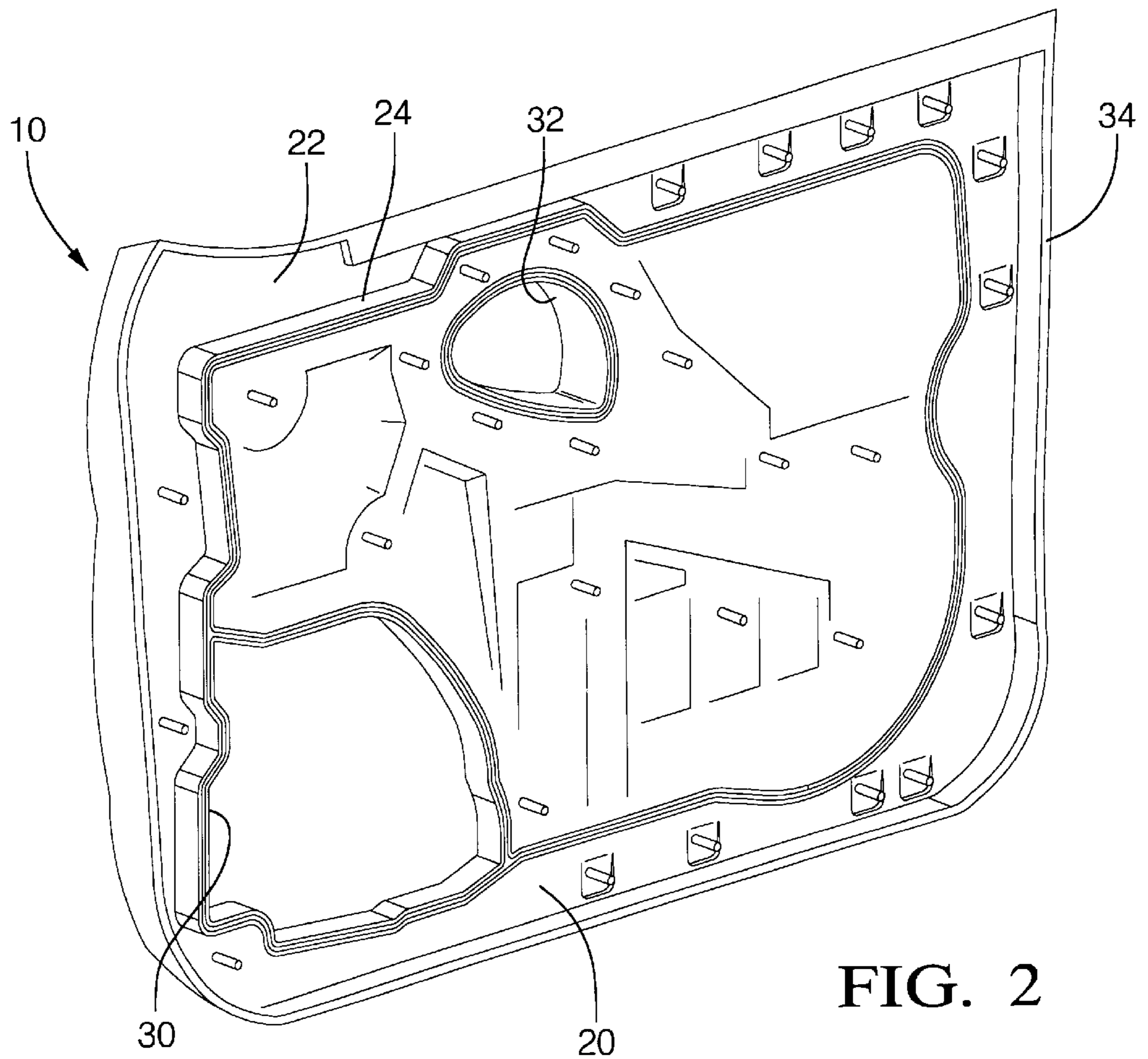


FIG. 2

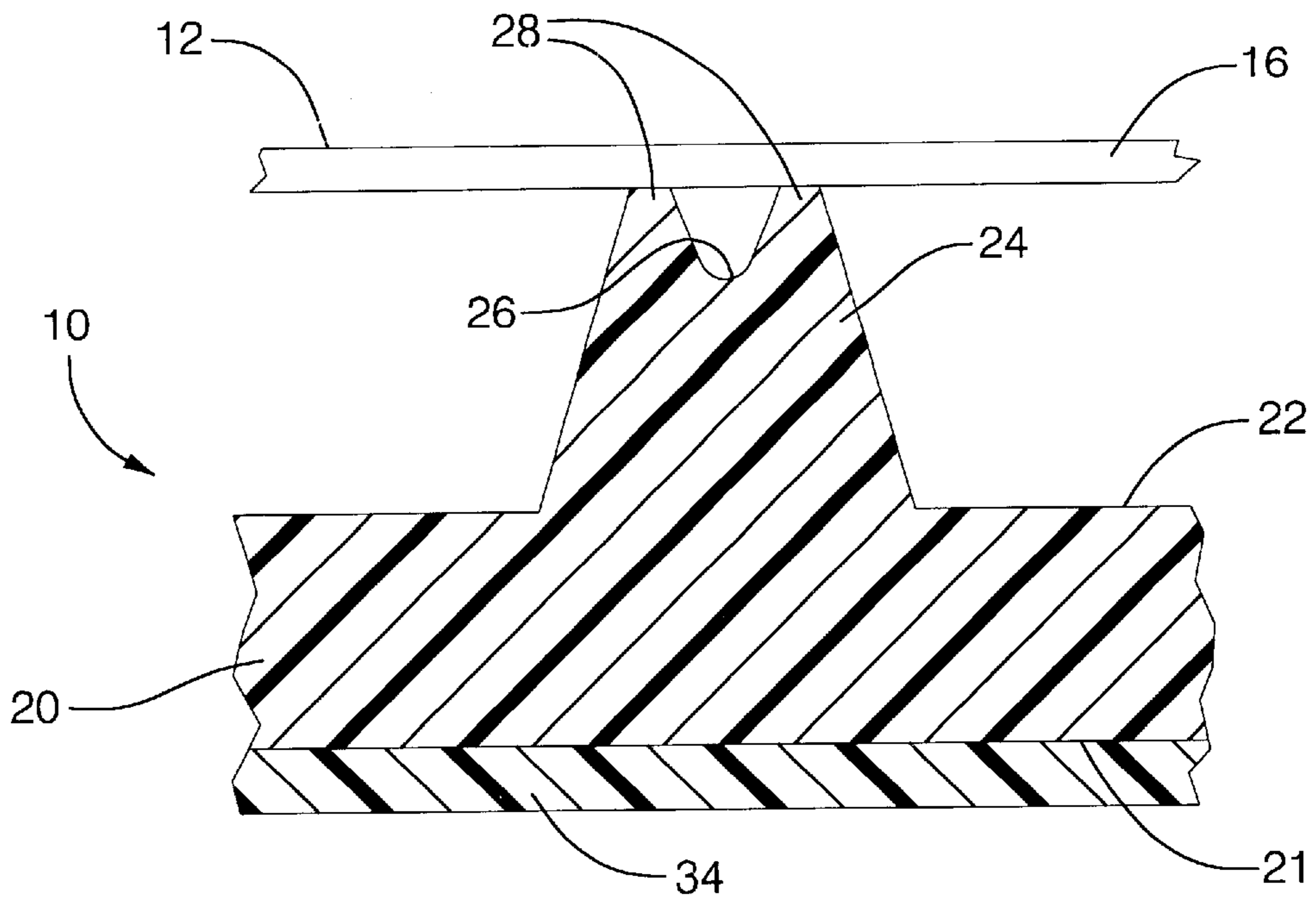


FIG. 3

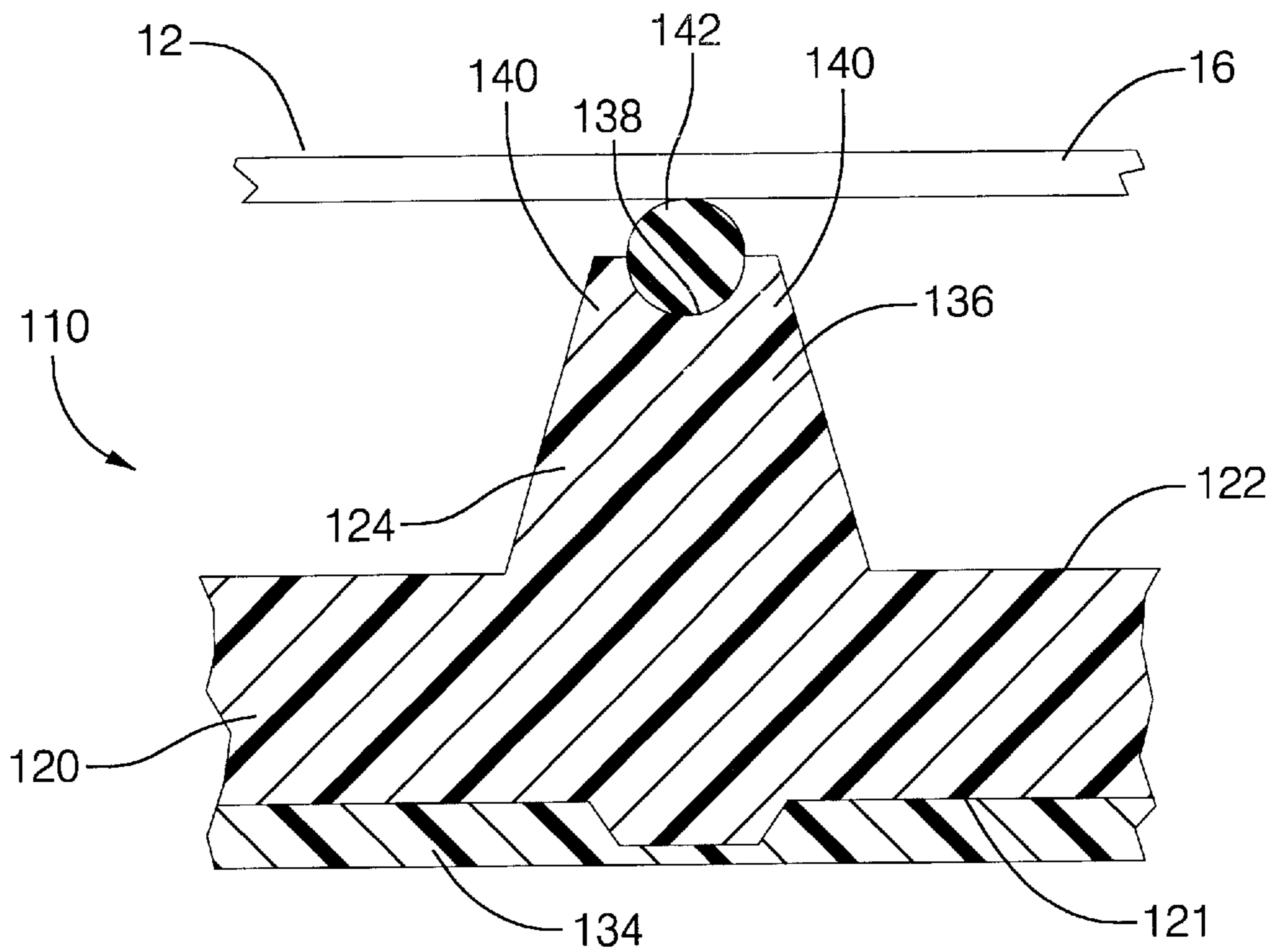


FIG. 4



## DOOR TRIM PANEL ASSEMBLY AND METHOD OF MAKING

### CROSS-REFERENCE TO RELATED APPLICATION(S)

The present invention claims the priority date of copending U.S. Provisional Patent Application Serial No. 60/173,654, filed Dec. 30, 1999.

### TECHNICAL FIELD

The present invention relates generally to door trim panels for vehicles and, more particularly, to a door trim panel assembly for a vehicle.

### BACKGROUND OF THE INVENTION

It is known to provide a door trim panel assembly for a vehicle such as an automotive vehicle to present an aesthetically pleasing appearance in an occupant compartment of the vehicle. The door trim panel assembly includes a plurality of separate components with each component having a specific function. The components typically include a door trim panel, sound absorber, water barrier, insert, armrest, map pocket closeout, and side impact blocks. The components are assembled together and attached to a door trim substrate by several different conventional processes including adhesives, heat staking, sonic welding, and fasteners.

The door trim substrate supports the components including the door trim panel and is not thick enough to touch an inner panel of the door since the materials for the substrate cannot be molded that thick. As a result, the door trim panel assembly uses a flat or pre-molded sheet material in conjunction with a bead of pre-applied butyl caulk. A release paper is attached to the caulk so that the parts can be stacked. The door trim panel assembly is then mounted to the inner panel of the door for the vehicle by removing the release paper and attaching with suitable means such as fasteners.

Although the above door trim panel assembly has worked, it is desirable to provide a seal on a backside or outer surface thereof of the door trim panel assembly. It is also desirable to provide a door trim panel assembly with an integrally molded seal in an expanded polypropylene substrate that reduces parts, cost, and assembly. It is further desirable to provide a door trim panel assembly with a direct applied seal and an expanded polypropylene substrate that reduces parts, cost, and assembly. Therefore, there is a need in the art to provide an improved door trim panel assembly for attachment to an inner panel of a door for a vehicle that meets these desires.

### SUMMARY OF THE INVENTION

It is, therefore, one object of the present invention to provide a new door trim panel assembly for a vehicle.

It is another object of the present invention to provide a door trim panel assembly that has an integrally molded seal into a single component for attachment to an inner panel of a door for a vehicle.

It is yet another object of the present invention to provide a door trim panel assembly that has a direct applied seal into a single component for attachment to an inner panel of a door for a vehicle.

It is still another object of the present invention to provide a door trim panel assembly that has fewer components and cost.

To achieve the foregoing objects, the present invention is a door trim panel assembly for attachment to structure of a

vehicle including a door trim panel and a carrier formed from a plastic material attached to the door trim panel and for attachment to the structure of the vehicle. The door trim panel assembly also includes a seal integral with the carrier for contacting the structure to seal the carrier to the structure.

In addition, the present invention is a method of making a door trim panel assembly for attachment to structure of a vehicle. The method includes the steps of placing a door trim panel into a cavity of a mold and filling the cavity with a plastic material. The method also includes the steps of introducing steam into the mold to expand the plastic material to form a carrier with an integral seal and bond the carrier against the door trim panel to form a single door trim panel assembly.

One advantage of the present invention is that a new door trim panel assembly is provided for a vehicle. Another advantage of the present invention is that the door trim panel assembly has an integrally molded seal and/or direct applied seal with an expanded polypropylene carrier or substrate that eliminates traditional watershields in doors for vehicles. Yet another advantage of the present invention is that the door trim panel assembly reduces the number of parts, labor, cost, and tooling for the same. Still another advantage of the present invention is that the door trim panel assembly improves serviceability and assembly plant handling since butyl caulk and release paper are eliminated. A further advantage of the present invention is that the door trim panel assembly has enhanced performance and saves the cost of traditional watershields, which increases the content on the door trim.

Other objects, features, and advantages of the present invention will be readily appreciated, as the same becomes better understood, after reading the subsequent description taken in conjunction with the accompanying drawings.

### BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of a door trim panel assembly, according to the present invention, illustrated in operational relationship with a vehicle.

FIG. 2 is a perspective rear view of the door trim panel assembly of FIG. 1.

FIG. 3 is a fragmentary view of an integrally molded seal of the door trim panel assembly of FIG. 1.

FIG. 4 is a fragmentary view of another embodiment, according to the present invention, of the door trim panel assembly of FIG. 1 illustrating a direct applied seal of the door trim panel assembly.

FIG. 5 is a fragmentary elevational view of a mold for a method, according to the present invention, of making the door trim panel assembly of FIG. 1.

### DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawings and in particular FIGS. 1 and 2, one embodiment of a door trim panel assembly **10**, according to the present invention, is shown for mounting to structure such as a door **12** of a vehicle **14**. It should be appreciated that, in this example, the door trim panel assembly **10** is mounted to an inner panel **16** of the door **12**. It should also be appreciated that the door trim panel assembly **10** may be an assembly mounted to other panels of the vehicle **14**.

Referring to FIGS. 2 and 3, the door trim panel assembly **10** includes a door trim substrate or carrier **20** extending longitudinally and vertically and having a generally rectan-

gular shape. The carrier **20** is made of a plastic material such as polypropylene. Preferably, the carrier **20** is made of expanded polypropylene (EPP). The carrier **20** is formed by a method, according to the present invention, to be described. The carrier **20** has a first side **21** and an opposed second side **22**. The second side **22** is attached to the inner panel **16** of the door **12** by suitable means such as fasteners (not shown). It should be appreciated that the carrier **20** may be molded thick enough to contact the inner panel **16** of the door **12** when mounted to the door **12**.

The door trim panel assembly **10** also includes at least one seal **24** incorporated or integrated into the carrier **20**. The seal **24** extends longitudinally and vertically around the carrier **20**. The seal **24** has a groove **26** extending therealong and inwardly to form a pair of laterally spaced projections **28**. The groove **26** allows the projections **28** to compress and seal against the inner panel **16** of the door **12**. The seal **24** is made of a plastic material such as polypropylene, preferably expanded polypropylene. The expanded polypropylene is compliant enough at predetermined densities (2.8 to 3.5 pcf) to conform to the sheet metal of the inner panel **16** of the door **12**. The seal **24** is molded as part of the second side **22** of the carrier **20** by the plastic material of the carrier **20**. It should be appreciated that the seal **24** and carrier **20** are integral, unitary, and formed as one-piece. It should also be appreciated that the seal **24** surrounds any openings **30,32** in the inner panel **16**, as well as the entire perimeter of the inner panel **16** of the door **12**. It should be further appreciated that the seal **24** acts as a water seal and water that enters the interface area between the door trim panel assembly **10** and the inner panel **16** of the door **12** is channeled to drains (not shown) at the bottom of the door **12**. It should be still further appreciated that the seal **24** is illustrated as uncompressed in FIG. 3.

The door trim panel assembly **10** includes a finished door trim panel **34**. The door trim panel **34** extends longitudinally and vertically and is generally rectangular in shape. The carrier **20** conforms to the shape of the door trim panel **34** such that the carrier **20** is disposed within the door trim panel **34**. The door trim panel **34** is made of a relatively rigid material such as hard plastic, covered plastic, and covered cellulose based material or composite of the like. The covering can be fabric, vinyl, cloth, TPO, leather, carpet, or a combination thereof. The door trim panel **34** is formed by a suitable thermoplastic molding or forming process such as injection molding, compression molding, thermoforming or the like. Preferably, the door trim panel **34** is made of polypropylene and formed by conventional injection molding processes as is known in the art. The door trim panel **34** is attached to the carrier **20** by molding the carrier **20** to the door trim panel **34** by a method to be described. It should be appreciated that the door trim panel **34** presents a class A surface as is known in the art. It should also be appreciated that the door trim panel **34** is conventional and known in the art.

Referring to FIG. 4, another embodiment **110**, according to the present invention, of the door trim panel assembly **10** is shown. Like parts of the door trim panel assembly **10** have like reference numerals increased by one hundred (100). In this embodiment, the door trim panel assembly **110** includes the carrier **120** having the first side **121** and the second side **122** and the door trim panel **134**. The door trim panel assembly **110** also includes the seal **124** having at least one seal retainer **136** incorporated or integrated into the carrier **120**. The seal retainer **136** extends longitudinally and vertically around the carrier **120**. The seal retainer **136** has a groove **138** extending therealong and inwardly to form a pair

of laterally spaced projections **140**. The seal **124** also includes a directly applied sealing member **142** disposed in the groove **138** to compress and seal against the inner panel **16** of the door **12**. The seal retainer **136** is made of a plastic material such as polypropylene. The sealing member **142** is made of a suitable material such as butyl rubber, one component urethane, two component urethane, no tack foamed hot melt, low tack foamed hot melt, high tack foamed hot melt, silicone or the like. The seal retainer **136** is molded as part of the second side **122** of the carrier **120** by the plastic material of the carrier **120**. It should be appreciated that the seal retainer **136** and carrier **120** are integral, unitary, and formed as one-piece. It should also be appreciated that the sealing member **142** is illustrated as uncompressed in FIG. 4.

A method, according to the present invention, of making the door trim panel assembly **10** is disclosed. A mold, generally indicated at **50**, includes a first half mold **52** and a second half mold **54**. The first and second half molds **52** and **54** are generally hollow to form a chamber **56**. The first and second half molds **52** and **54** have an inlet **58** for allowing a fluid such as steam to enter the chamber **56** of the first and second half molds **52** and **54**. The first and second half molds **52** and **54** each include a mold cavity **60** for forming the carrier **20**. The first half mold **52** includes at least one, preferably a plurality of fill inlets **62** extending into the mold cavity **60** to allow fill guns (not shown) to fill the mold cavity **60** with the plastic material for the carrier **20**. It should be appreciated that the mold **50** is conventional and known in the art.

The method, according to the present invention, includes the step of forming the door trim panel **34,134** by conventional processes such as injection molding or other suitable thermoplastic molding or forming process (i.e., compression molding, thermoforming, etc.). The door trim panel **34,134** is preferably designed with at least one, preferably a plurality of "undercut" members to facilitate mechanical bonding of the carrier **20,120**. The method may include the step of preheating the door trim panel **34,134** using an infrared oven (not shown) or the like. Preferably, the door trim panel **34,134** would be demolded from the injection molder (not shown) at higher-than-ambient temperature and placed into the mold cavity **60** of the mold **50**.

The method includes the step of placing the door trim panel **34,134** into the mold cavity **60** of the mold **50**. The method includes the step of closing the mold **50** and filling the mold cavity **60** with the plastic material for the carrier **20,120**. In the preferred embodiment, the plastic material is expanded polypropylene. As such, the mold cavity **60** is filled with beads of expanded polypropylene, which enter the mold **50** via the fill inlets **62**. Next, the method includes the step of introducing steam into the mold **50** via the inlets **58** to expand the plastic material to form the carrier **20, 120** and seal **24** or seal retainer **136** and bonding the plastic material to the door trim panel **34,134** to form a single door trim panel assembly **10,110**. In particular, steam enters the chambers **56** of the first and second half molds **52** and **54** through the inlets **58**. The beads of expanded polypropylene are fused together with mechanical and thermoplastic bonding occurring to the door trim panel **34,134**. It should be appreciated that the steam enters through openings in the door trim panel **34,134** and through openings in the first half mold **52** to expand the beads of polypropylene.

The method may include the step of cooling the mold **50** by spraying a coolant such as water through nozzles (not shown) onto the backside of the mold cavity **60** of the mold **50**. Once the door trim panel assembly **10,110** is cooled or

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after a suitable time for fusion and cooling, the method includes the step of opening the mold **50** and removing or demolding the door trim panel assembly **10,110** from the mold **50**.

For the door trim panel assembly **110**, the method includes the step of placing the door trim panel assembly **110** on a holding fixture (not shown) and applying the sealing member **142** to the seal retainer **136** by an apparatus such as a robot (not shown) and disposing the sealing member **142** in the groove **138**. Finally, the method includes attaching the door trim panel assembly **10,110** to the inner panel **16** of the door **12** by suitable means such as fasteners, adhesives, heat staking, sonic welding or the like or the natural adhesive characteristics of the seal material itself (foamed hot melts) to hold the seal **24,124** tightly against the inner panel **16** of the door **12**. It should be appreciated that the seal **24** or applied sealing member **142** in combination with the expanded polypropylene (EPP) material or surface itself seals water and vapor from entering the vehicle **14** through the door **12**.

The present invention has been described in an illustrative manner. It is to be understood that the terminology, which has been used, is intended to be in the nature of words of description rather than of limitation.

Many modifications and variations of the present invention are possible in light of the above teachings. Therefore, within the scope of the appended claims, the present invention may be practiced other than as specifically described.

What is claimed is:

**1.** A door trim panel assembly for attachment to structure of a vehicle comprising:

a door trim panel;

a carrier formed from a plastic material disposed within said door trim panel and attached to said door trim panel for attachment to the structure of the vehicle; and

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a seal integral with said carrier for contacting the structure to seal said carrier to the structure.

**2.** A door trim panel assembly as set forth in claim **1** wherein said plastic material is comprises expanded polypropylene.

**3.** A door trim panel assembly as set forth in claim **1** wherein said seal extends longitudinally and vertically around said carrier.

**4.** A door trim panel assembly for attachment to a structure of a vehicle comprising:

a door trim panel;

a carrier formed from a plastic material attached to said door trim panel and for attachment to the structure of the vehicle; and

a seal integral with said carrier for contacting the structure to seal said carrier to the structure, wherein said seal includes a groove extending therealong and inwardly.

**5.** A door trim panel assembly as set forth in claim **4** wherein said seal includes a pair of laterally spaced projections, said groove being disposed between said projections.

**6.** A door trim panel assembly as set forth in claim **4** wherein said seal includes a sealing member disposed in said groove.

**7.** A door trim panel assembly as set forth in claim **1** wherein said carrier has a first side and a second side.

**8.** A door trim panel assembly as set forth in claim **7** wherein said seal extends from said second side.

**9.** A door trim panel assembly as set forth in claim **1** wherein said seal comprises expanded polypropylene.

**10.** A door trim panel assembly as set forth in claim **1** wherein said seal and said carrier are integral, unitary, and one-piece.

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